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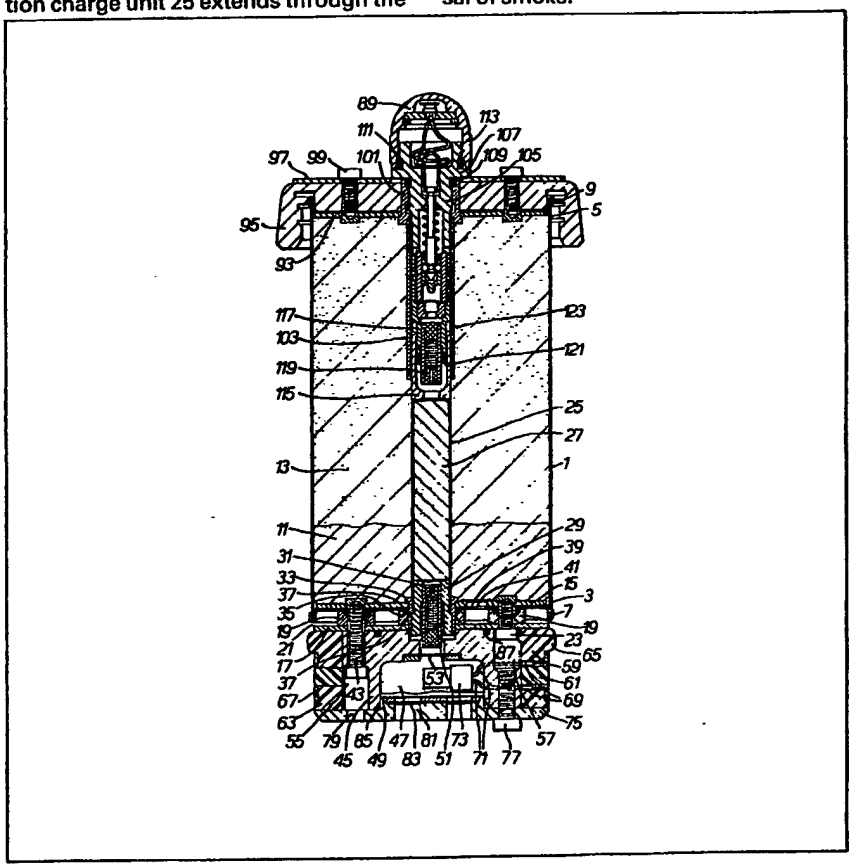
(54) **Smoke projectile**

(57) A smoke projectile comprises a sidewall 1 and first 3 and second end covers 93 defining a canister containing a smoke composition 13, the first end cover being formed with a central aperture 37 and with a plurality of outflow apertures 41 for smoke. A central ignition charge unit 25 extends through the central aperture into the smoke composition. A contact head 59 formed with a central propellent charge chamber 49 in which there are a propellent charge 47 and a primer capsule 73 is also provided and has external contact rings 67 and firing circuits 71 whereby an electric current can be passed to the primer capsule. A smoke pressure chamber has a flat cover 15 fixed to the first end cover of the projectile container and formed with apertures 39 registering with said outflow apertures 41, and has a base 17 against which the contact head is secured, there being spacer members 19 between the cover and base of the smoke pressure chamber so as to define an annular slot 21 for the escape of smoke gases. If desired, a firing pin ignition unit 105 may be mounted on the second end cover of the projectile canister. The arrangement of the smoke pressure chamber and the annular slot facilitates the even dispersal of smoke.



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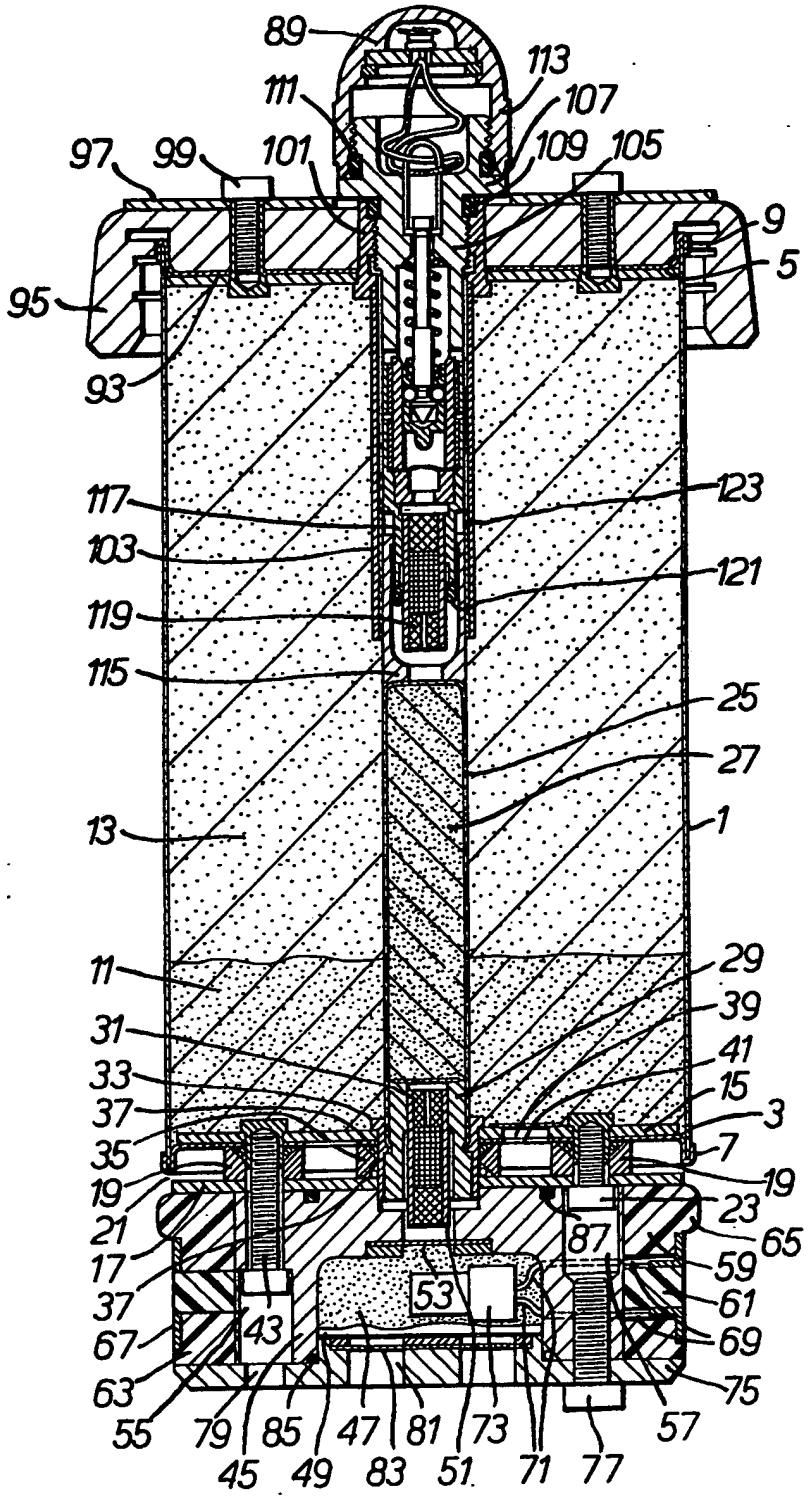
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SPECIFICATION

Smoke projectile

This invention relates to a smoke projectile and is particularly concerned with a smoke projectile of the kind comprising a projectile container in the form of a canister which is capable of withstanding the pressure of the hot smoke gases produced when a smoke composition present in the container is ignited and in which there is a central ignition charge unit extending into the smoke composition and provided with an ignition charge, and a contact head fixedly connected to the projectile container, in which there is a centrally mounted propellent charge chamber provided with a propellent charge which can be electrically ignited by means of a primer capsule, firing circuits and contact rings on the outer surface of the contact head, whilst the ignition charge unit is connected coaxially to the propellent charge chamber via an ignition delay member. If desired, a firing pin ignition unit capable of being actuated by manual tension is also provided.

A smoke candle for use either for throwing or for firing has already been described in DE-AS 12 85 919, and comprises a canister open at the top and containing a smoke composition, and a contact head which closes the opening and is provided with gas outlet openings, means for both electrically igniting a propellent charge and for manually actuating a friction igniter acting via a delay composition being mounted in or on said contact head. In this smoke candle the propellent charge and a single ignition charge are arranged axially behind one another in the centre of the contact head, whilst a friction igniter and a plurality of gas outlet openings covered by breaking points are grouped around these charges, the ignition charge being effectively connected to the propellent charge and being also effectively connected to the friction igniter via the delay composition. The gas outlet openings are preferably conical in form so that their internal width increases from the inside of the contact head outwards. The core of the contact head, and thus practically the entire contact head, consists of a compression moulding of conventional plastics.

The arrangement of a plurality of gas outlet openings around the central propellent charge, in the contact head just described, is intended to bring the advantage that, in this way, it is possible to yield to the pressure increase inside the canister containing the smoke composition when using smoke compositions with a high intensity of smoke formation, without the contact head being damaged or prematurely torn right off by the gas pressure from within. Therefore, a smoke candle provided with a contact head of this kind is supposed to be capable of being used with smoke compositions which produce more intensive smoke than usual, although there are no details whatsoever as to the nature and composition of these smoke compositions.

However, the smoke candle described in the above mentioned DE-AS 12 85 919 has the following serious disadvantages. Firstly, the smoke gases only emerge in a jet through the gas outlet openings in the contact head, in the longitudinal direction relative to the smoke candle, this direction being determined by these openings, and then, as the reaction proceeds, the contact head, which is made of plastics, is melted and thus destroyed, since it is not protected in any way. This occurrence is promoted even more when intensive smoke compositions such as titanium-containing smoke compositions, for example, are used, owing to the elevated temperature of the titanium-containing combustion products. As a result, the contact head is thus very soon destroyed, and consequently the gas outlet openings originally contained therein are only operational for a short time. Then, as the reaction continues, the smoke gases escape in a totally uncontrolled manner. Thus, in a smoke candle of this kind, an escape of smoke over a large area all round, with a large, spherical cloud of smoke, is not possible, either at the start or as the smoke forming reaction proceeds, but instead there is only a jet of escaping smoke oriented more or less exclusively to one end. The high gas velocity required to spread the smoke over a large volume, i.e. an increase in the gas pressure by accumulation, is not achieved with a smoke candle of this kind by its very construction. Moreover, owing to the chemical reaction of the smoke gases with the plastics material of the contact head, there is also a further weakening in the smoke output, which is unsatisfactory to start with. In addition, owing to the fact that the smoke comes out in a jet, as mentioned above, there is always the danger, when smoke candles of this kind are fired simultaneously in the usual way, that they will not form a solid wall of smoke, but will form a wall of smoke with gaps in it, since the smoke output from the different smoke candles cannot combine to form a solid wall unless they are positioned accurately relative to one another, owing to the release of the gases in streams. In smoke candles of this kind, the formation of smoke with constant intensity and the release of smoke on all sides irrespective of position cannot be achieved, owing to the constructional defects mentioned above.

In DE-AS 14 28 657, a smoke projectile is described wherein the smoke composition can be ignited by hand using a friction igniter and, when fired from a launcher, is ignited by means of an electric igniter which ignites the propellent charge, whilst the friction igniter acts on a booster charge via a delay composition and the electric igniter embedded in the propellent charge also acts on a booster charge, and the friction igniter and electric igniter are mounted eccentrically in the head of the projectile and a firing connection is provided between the two spark gaps. In this latter smoke projectile, the two booster charges are combined to form an ignition ring which is connected to each of the two spark gaps via a delay composition. The ignition ring is placed in a groove in a disc, preferably made of plastics, which is arranged as a spacer between the smoke composition and a cover which closes off the projectile housing at the igniter end, and this disc comprises bores for the passage of the delay compositions (and hence, indirectly, of the smoke gases too). The outer edge of the contact head facing the projectile

housing is raised and constructed to engage in the flange of the projectile housing so that, to some extent, a chamber is thus formed between the cover or the ignition ring and the contact head. However, this chamber is merely an accidental result of the construction and has no function of any kind as regards having a particular effect on the smoke gases formed by the combustion of the smoke composition, as it does not comprise any special outlet openings for the smoke gases and again the contact head which essentially forms this chamber is made of plastics in the usual way. Therefore, a smoke projectile of this kind has, to an even greater degree, all the disadvantages mentioned hereinbefore with reference to the smoke action in connnection with DE-AS 12 85 919. Intensive discharge of gases all round is not possible with this smoke projectile, and in particular the effective use of smoke compositions with very intensive smoke formation, such as titanium-containing smoke compositions, for example, is impossible.

In DE-PS 12 54 510, a smoke candle is described wherein the contact head is constructed and arranged in just the same way as in DE-AS 14 28 657. Therefore, the outer edge of the contact head facing the projectile housing is also raised and constructed so as to engage in the flange of the projectile housing, so that again a chamber is formed between the cover of the projectile housing and the contact head. However, instead of an ignition ring, two eccentrically mounted rod-shaped ignition charge units are provided, arranged coaxially with the friction igniter or the propellent charge and immersed in the smoke composition, and wherein, in the region inside the projectile housing facing the cover and hence the contact head as well, there is a relatively large expansion chamber for the smoke gases. For mechanically stabilising this expansion chamber and securely mounting the two ignition charge units and the contact head, an intermediate plate and a reinforcing plate, both made of steel, are provided on the cover of the projectile housing. Breakage points for the escape of the smoke gases into the cavity formed by the contact head together with the cover of the smoke candle canister (projectile housing) are provided on the outer edge, not covered by the intermediate plate and reinforcing plate, of the cover of the smoke candle canister. Again, the contact head is made of plastics, and it is even expressly stated that it must be a plastics material, such as polystyrene, which melts under the effect of the smoke gases. Thus, this smoke candle has the same disadvantages as the above mentioned smoke projectile according to DE-AS 14 28 657.

A smoke candle is described in DE-PS 11 85 510 which is similar in construction to the one according to DE-PS 12 54 510, but has a solid moulded plastics contact head which does not leave any chamber of any kind between the cover of the smoke candle canister, there being no expansion chamber for the smoke gases inside the canister. However, smoke outlet holes, in the form of breakage points, for the escape of the clouds of smoke formed from the smoke composition, are provided along the casing of the smoke candle canister. Thus, only random amounts of smoke gas can escape through the cover of the smoke canister which is located on the contact head, by conventional destruction of the contact head and of the rod-shaped ignition charge units which pass into the smoke composition.

Thus, the outlet holes formed in the pot-shaped container projecting out of the base of the contact head for receiving the propellent charge serve only to release the combustion gases of the propellent charge when this smoke candle is fired from a launcher and they do not contribute in any way to a specific development and spreading of smoke.

No information is given as to the synthesis and composition of the smoke composition to be used with the smoke canister according to the above mentioned DE-PS 11 85 510. However, in addition to smoke compositions based on hexachloroethane and similar halohydrocarbons, preferably chlorinated hydrocarbons, which burn with almost no residue, there are also various other smoke compositions which leave a large residue when burned, and this then makes it much more difficult for the clouds of smoke to escape. The distance between the reaction zone and the possible outflow openings must therefore be kept as short as possible when smoke compositions of this kind are used. These smoke compositions are preferably used in a smoke candle of the above type, and therefore the above mentioned smoke outlet holes are and have to be provided in the smoke candle canister for the reasons stated. As no special precautions are taken to achieve some accumulation and a specific guiding of the smoke gases formed, the above smoke candle is not suitable for increasing the intensity of the smoke gases and for obtaining the desired extensive escape of smoke on all sides, either when using low-residue smoke compositions or when using smoke compositions which burn with a large residue.

A smoke candle is described in DE-PS 11 00 507 which is provided with two ignition charges independent of each other and engaging eccentrically in the smoke composition and with a propellent charge, in which one ignition charge is ignitable by hand using a friction igniter and the other ignition charge is ignitable by means of the combustion gases of the propellent charge and, after the smoke candle has been placed in a launcher, is electrically ignited from outside. The smoke candle canister is completely filled with a smoke composition and the cover of the canister is fixedly connected flush to a plastics contact head, without leaving any chamber therebetween. No special breakage points or throughflow openings for the controlled outlet of the smoke gases are provided in the canister cover or in the contact head. Instead, in this smoke candle, the smoke is released at one end through perforations in the base of the canister and in the contact head for receiving the two ignition charges and their ignition delay members, at the start of the reaction, and as the reaction proceeds and the contact head is progressively destroyed, the smoke is discharged completely randomly. Thus, with this smoke candle, it is again impossible to increase the intensity of the smoke gases and to achieve extensive release of the

smoke on all sides.

It is apparent from the foregoing comments that all these previously proposed smoke projectiles have the disadvantage that the clouds of smoke have a low speed of escape and that the escape of the smoke is either totally uncontrolled or is only briefly controlled and then takes the form of a trail of smoke. Thus, it is not possible to obtain a distribution of smoke over a large area at high speed so as reliably to result in the formation of a completely solid wall of smoke.

As has already been mentioned, the smoke compositions contained in the previously proposed smoke projectiles are usually based on chlorinated hydrocarbons, particularly hexachloroethane, and metal powders, particularly zinc and/or aluminium powder, and optionally metal oxides, especially zinc oxide. This category also includes smoke compositions in which the metal powder component consists wholly or partially of titanium powder. Smoke compositions consisting of hexachloroethane and titanium powder alone are described, for example, in TECHNIK UND VERSORGUNG 1970, pp.63-68, especially page 66, right-hand column. Pyrotechnic compositions for producing smoke effects, consisting of a mixture of hexachloroethane, zinc oxide and titanium in finely divided form, are described in DE-AS 10 63 507, the proportion of titanium used being preferably chosen so that the quantity of zinc oxide present is reduced to zinc after the composition has been ignited. Compositions consisting of about 43% zinc oxide, 43% hexachloroethane and 14% titanium are particularly preferred. Smoke compositions based on hexachloroethane and metal powders, especially magnesium and/or aluminium powder, wherein the magnesium and/or aluminium portion is wholly or partly replaced by titanium, this titanium content preferably being about 5%, are known from DE-AS 10 74 469.

The advantages of using titanium in smoke compositions include, *inter alia*, the fact that the active ingredient of the smoke thus formed has a lower condensation point than the active ingredient in compositions containing zinc or zinc oxide. It can therefore penetrate a comouflage layer or a covering of snow much more easily and, because of this, remains fully effective even when used in deep snow. Moreover, it is effective not only in the visible range but also in the infra-red range of the electromagnetic spectrum. However, a major disadvantage of these smoke compositions is that the titanium powder required for them is relatively expensive and therefore these conpositions are used only in special circumstances.

It is an object of the invention to provide a smoke projectile which, in use, will cause intensive, spontaneous smoke formation from the outset, with the clouds of smoke streaming out at high speed being distributed over a large area all round the projectile, and also to provide a smoke projectile in which it is possible to use a titanium-containing smoke composition based on chloroinated hydrocarbons and reaction-accelerating metal powders, in which the usual content of titanium powder is replaced by a cheaper titanium compound.

According to the present invention there is provided a smoke projectile, comprising a sidewall and first and second end covers together constituting a projectile container in the form of a canister and of sufficient strength to be capable of withstanding the pressure generated by hot smoke gases upon ignition of a smoke composition in the container, said first end cover being formed with a central aperture and with a plurality of outflow apertures surround said central aperture, a central ignition charge unit extending into said smoke composition from one end of said container and through the central aperture in said first end cover, an ignition charge to said ignition charge unit, a contact head formed with a central propellent charge chamber, a propellent charge in said chamber, a primer capsule to said contact head for igniting said propellent charge, firing circuits to said contact head, contact rings arranged on the outer surface of the contact head whereby an electric current can be passed through said contact rings and said firing circuits to fire said primer capsule, and ignition delay member connecting the ignition charge unit to the propellent charge chamber coaxially of the projectile, a substantially flat smoke pressure chamber cover fixedly connected to said first end cover and formed with throughflow apertures in register with the outflow apertures in said first end cover, a smoke pressure chamber base and spacer members arranged between the smoke pressure chamber cover and base thereby to define a smoke pressure chamber of substantially the same peripheral extent as the first end cover with an annular slot for the escape of smoke gases.

The spacers provided in the smoke pressure chamber are preferably spacer rings which are mounted round screws which fixedly connect the smoke pressure chamber and, optionally, the contact head to the first end cover of the projectile container. The height of the spacers is such that the annular slot required for the smoke pressure chamber is formed as a flow restriction as the result of which it is possible to obtain an adequate build-up of pressure of the smoke gases and hence a corresponding increase in their speed of escape.

The smoke pressure chamber formed by the cover and base of the smoke pressure chamber in conjunction with the spacers is preferably surrounded, on its outer periphery, by a flange of the first end cover of the projectile container, leaving an annular slot for the escape of the smoke gases. Thus, the flange of the end cover of the projectile container forms the annular outer boundary of the smoke pressure chamber, whilst the annular slot for the escape of the smoke gases is left free on that part of the flange which faces the base of the smoke pressure chamber, the height of the slot being determined by the height of the spacers.

In theory, the cover of the smoke pressure chamber may be placed directly on that side of the front end cover of the projectile container which is located outside the projectile container, but it is preferably located on that side of the end cover of the projectile container which is inside the projectile container. Therefore, for this purpose, the first end cover of the

projectile container is preferably arranged between the cover and base of the smoke pressure chamber. This construction and arrangement of the smoke pressure chamber results in a firm, well fitting connection to the end cover of the projectile container and hence to the projectile container as a whole. The solid, substantially flat cover of the smoke pressure chamber located inside the projectile container advantageously acts as a mounting plate for the ignition charge unit which extends into the smoke composition and comprises an ignition charge, and at the same time is used for screwing to the base of the smoke pressure chamber, which is also substantially flat, and possible to the contact head as well. In addition to the corresponding throughflow openings for the smoke gases, the cover of the smoke pressure chamber is also formed with bores or threaded holes for receiving corresponding screws, whilst in addition a connecting bore for the passage of the ignition charge unit is also provided in the cover of the smoke pressure chamber. Naturally, a corresponding connecting bore is also formed in the base of the smoke pressure chamber, which is further formed with bores or threaded holes for receiving screws by means of which this base can be screwed to the contact head and to the front end cover of the projectile container and the cover of the smoke pressure chamber. All these bores and threaded holes are sealed off in substantially gastight manner from the components located therein, such as the ignition charge unit and screws. That part of the ignition charge unit located in the region of the smoke pressure chamber preferably consists of a securing ring socket provided with a corresponding bore, the ignition delay member connected to the propellent charge being inserted in that end of said securing ring socket which faces the contact head, whilst on its end which is located inside the projectile container there is a sleeve in which the ignition charge is mounted. This sleeve is preferably a thin-walled aluminium sleeve. The gastight seal required between the smoke pressure chamber and the securing ring socket of the ignition charge unit can be obtained by mounting, around this securing ring socket, a conical ring tapering conically on both sides towards the latter, the internal diameter of which substantially corresponds to the outer diameter of the securing ring socket, whilst its height substantially corresponds to the height of the spacers, and by providing an O-ring in each of the wedge-shaped interstices thus formed between the cover and the base of the smoke pressure chamber and the securing ring socket. When the individual components are screwed together a gastight seal is thus provided by the compression of the O-rings.

The projectile container of this smoke projectile is preferably in the form of a canister made of tin-plate with flanged end covers. The flanging between the first end cover of the projectile container and the outer surface of the canister-shaped projectile container automatically provides the outer surround required for externally delimiting the smoke pressure chamber, whilst leaving a corresponding annular slot for the escape of the smoke gases.

The throughflow openings formed in the cover of the smoke pressure chamber and the outlet openings in the first end cover of the projectile container for the smoke gases, the latter openings coinciding with these through-flow openings, are preferably formed in known manner as breakage points which are opened by the pressure of the hot smoke gases when the smoke composition has been ignited. Appropriately, these breakage points are formed by covering the throughflow openings or outlet openings with lead or tin foil which is arranged using suitable means to form a tight seal. Preferably, there are six such throughflow openings or outlet openings for the smoke gases, with a diameter of, preferably, from about 8 to 10 mm.

Preferably, all the components of the smoke pressure chamber are made of steel.

In principle, the contact head of this smoke projectile may consist of any conventional electrically ignitable contact head wherein the propellent charge chamber is mounted centrally so as to be connected to the ignition charge unit, also mounted centrally, in the projectile container, via the ignition delay member located therein. Contact heads of this kind generally consist of compression-moulded plastics components with the ignition leads cast directly into their outer surfaces. However, in the smoke projectile according to the invention, a contact head as described in DE-OS 29 32 921 and shown in the drawing thereof is preferably used, that is to say in the Specification of our copending Patent Application filed on even date herewith.

Instead of mounting the smoke pressure chamber between the cover of the projectile container and the contact head it is theoretically also possible to provide this smoke pressure chamber in the region of the other end of the projectile container, but this is less preferable, for reasons of construction.

Thus, the essential point is that a corresponding separate smoke pressure chamber is mounted on the projectile container, and by its construction this chamber permits a directed release of the smoke gases to form a substantially spherical cloud of smoke.

A smoke projectile of the construction described above can be fired from conventional launchers equipped with means for electrical ignition. However, it is often necessary to be able to actuate such smoke projectiles manually, independently of any electrical ignition. Therefore, a preferred embodiment of the present smoke projectile contains, in addition to the electrically actuatable contact head, a firing pin ignition unit which can be actuated by manual tension, and which is conveniently mounted on the second end cover of the projectile container, coaxially with the ignition charge unit, and also extends into the smoke composition and is connected to the ignition charge unit via another ignition delay member. The ignition charge unit in the smoke composition and the firing pin ignition unit together preferably form a central channel extending right through the smoke composition. Thus the two units abut on each other at their end faces. For the firing pin ignition unit, any unit of known construction may be used in the present

smoke projectile, possibly adapted to the particular requirements by slight modifications. Firing pin ignition units suitable for this purpose are disclosed, for example, in DE-PS 12 13 326 and DE-PS 23 00 464 and in the other literature referred to therein.

In the present smoke projectile, the firing pin ignition unit is preferably arranged so that it can readily be replaced at any time. This is made possible by the construction of the igniter head, the components provided on the second end cover of the projectile container and the connecting point between the ignition charge unit and the neck of the igniter. For this purpose, the elastic covering cap conventionally provided in smoke projectiles is made large enough to fill the entire space formed by the second end cover of the projectile container and its flange with the casing of the canister-shaped projectile container. Inside the projectile container is provided a solid inner mounting disc, corresponding in its dimensions and structure to the end cover of the projectile container, and co-operating functionally with a corresponding outer mounting disc of substantially the same kind which is located on the elastic covering cap outside the projectile container. Passing through all these components, namely the outer mounting disc, the elastic covering cap, the second end cover of the projectile container and the inner mounting disc, there is a central bore in which is inserted a securing sleeve comprising, at its end facing the inside of the projectile container, a guide sleeve which extends practically to the end of the sleeve of the ignition charge unit. Bores, optionally having theads, are also formed in the above mentioned components, through which they can be fixedly screwed to the second end cover of the projectile container, forming a gas-tight seal. The resulting contact with the elastic covering cap automatically produces the desired seal.

The igniter head of the firing pin ignition unit is constructed so as to widen out to an annular seating at its end facing the protective cap. On the neck of the igniter head head abutting on this annular seating there is a constriction in which is provided an O-ring which engages in a corresponding recess in the securing sleeve. The igniter neck of the firing pin ignition unit is constricted at its end facing the ignition charge unit, and between this constriction and the end portion of the guide sleeve opposite it there is a coupling member which simultaneously also fits on the end of the sleeve of the ignition charge unit via a corresponding annular seating and also surrounds the latter. An O-ring is provided between the coupling member and the part of the igniter neck facing it. The coupling member and guide sleeve are connected more or less rigidly to each other via an interposed ring cone which is pressed in accordingly over the ring seating on the igniter neck, provided in the region of these components. In conjunction with the ring cone, the guide sleeve, the coupling member and the two O-rings, this results in a sealed mounting of the firing pin ignition unit in the projectile container and also makes it possible to exchange the firing pin ignition unit as desired.

Suitable smoke compositions include all the conventional smoke compositions based on chlorinated-hydrocarbons, reaction-accelerating metal powders and, optionally, metal oxides. However, smoke compositions based on chlorohydrocarbons and reaction-accelerating metal powders in which, as a new component, some of the metal powder is replaced by titanium dioxide, are particularly preferred.

In previously proposed titanium-containing smoke compositions based on chlorinatedhydrocarbons and reaction-accelerating metal powders, hitherto only titanium powder has been used as part of the reaction-accelerating metal powder, but not titanium dioxide. Therefore, smoke compositions based on chlorinatedhydrocarbons and reaction-accelerating metal powders which do not contain titanium powder but instead contain titanium dioxide must be regarded as new.

Accordingly, a further aspect of the invention provides in or for use in a smoke projectile a new smoke composition comprising a chlorinated hydrocarbon, a reaction-accelerating metal powder and titanium dioxide. Thus, the usual content of titanium powder is replaced by a cheaper titanium compound.

Preferably, this smoke composition contains hexachloroethane as the chlorinatedhydrocarbon and aluminium powder as the reaction-accelerating metal powder. Smoke compositions consisting of about 50 to 70% by weight hexachloroethane, about 5 to 20% by weight aluminium powder and about 20 to 30% by weight titanium dioxide are particularly suitable, and, more particularly, smoke compositions of this kind contain about 60 to 65% by weight hexachloroethane, about 7 to 15% by weight aluminium powder and about 25 to 28% by weight titanium dioxide.

Obviously, the quantities of hexachloroethane and aluminium powder given may be partly or wholly replaced by other chlorinatedhydrocarbons and reaction-accelerating metal powders.

The smoke composition contained in the present smoke projectile can be subdivided into a preliminary smoke composition and a main smoke composition in the usual way. When the new smoke composition containing titanium dioxide is used, a preliminary smoke composition consisting of about 59.5% by weight hexachloroethane, 15% by weight aluminium powder and 25.5% by weight titanium dioxide and a main smoke compositon consisting of about 65% by weight hexachloroethane, 7% by weight aluminium powder and 28% by weight titanium dioxide are preferred. Thus, the preliminary and main smoke compositions in practice differ only in that the former has a higher proportion of aluminium powder and is therefore more reactive.

The smoke compositions which may be used may also contain metal oxides, such as zinc oxide, manganese dioxide or copper oxide.

Any of the usual ignition charges for the particular smoke composition used, particularly for smoke compositions based on chloroinated hydrocarbons, may be used as the ignition charge in the present smoke projectile. So-called hot charges, which generally consist of magnesium and iron (III) oxide

powder, e.g. about 31.5% by weight magnesium powder and 68.5% by weight iron (III) oxide powder, are preferred. This charge is pressed into a thin-walled aluminium tube which melts away immediately upon combustion of the ignition charge, which reacts with great heat, and thus provides direct contact between this charge and the smoke composition. Since, furthermore, the reaction speed of the ignition charge is very great, the smoke composition is thus made to react spontaneously over the entire surface of the ignition charge. The thin-walled aluminium tube filled with the ignition charge connects the preliminary smoke and main smoke compositions to each other, so that both compositions are made to react simultaneously over the entire length of the aluminium tube. In this way, a smooth transition from the fast-reacting preliminary smoke composition to the slower reacting main smoke composition is achieved.

Conventional delay members which produce the required delay are provided in the present smoke projectile. A delay of about 0.8 to 1.2 seconds, for example, is sufficient for the delay member provided between the propellent charge chamber and the ignition charge unit. For the other delay member provided between the firing pin ignition unit and the ignition charge unit, the delay should be rather longer, in the interests of safety.

Similarly, any propellent charge normally used in smoke projectiles of this kind and capable of being electrically ignited by means of a primer capsule can be used as the propellent charge for the propellent charge chamber.

The smoke projectile according to the invention operates as follows:

The ignition charge unit provided in the smoke projectile and comprising an ignition charge is ignited electrically, when the smoke projectile is fired, or ignited manually, by actuation of the firing pin ignition unit, when the smoke projectile is simple thrown, and the ignition charge thus ignited then causes spontaneous, intensive ignition of the smoke composition provided in the smoke projectile. The hot smoke gases thus formed pass at high speed through the thrcughflow openings in the cover of the smoke pressure chamber and through the outlet openings coinciding therewith in the front end cover of the projectile container, forcing open any breakage points provided, into the chamber area of the smoke pressure chamber, and then pass through the annular slot into the open air. Thus, because of the construction of the smoke pressure chamber, the desired smoke is spontaneously released, forming a spherical cloud of smoke. If the intention is to make a smokescreen round a vehicle, such as a combat tank, for example, a series of, generally, 8 to 12 smoke projectiles are fired. By the spherical expansion of the cloud of smoke which is spontaneously formed, a dense, solid wall of smoke is produced very quickly, i.e. within a few seconds. The delay between firing and the start of the smoke reaction is appropriately such that the projectiles start to smoke while still in flight and so create a curtain of smoke even at this stage.

Since the smoke projectile according to the invention can be used with a new smoke composition containing titanium dioxide, it is possible to make use of the known advantages of titanium-containing smoke compositions using cheap titanium dioxide instead of titanium powder, which is relatively expensive.

In order to enable the invention to be more readily understood, reference will now be made to the accompanying drawing, which illustrates diagrammatically and by way of example an embodiment thereof, and which is a longtitudinal section through a smoke projectile according to the invention.

Referring now to the drawing, there is shown a projectile container 1 which is in the form of a canister and which is provided with two end covers 3 and 5. The first end cover 3 and the second end cover 5 of the projectile container are each connected in a tightly sealed manner to the casing of the container 1 by means of flanges 7 and 9 respectively. The projectile container 1, its covers 3 and 5 are conveniently made of tin-plate. The projectile container 1 contains a preliminary smoke composition 11 and a main smoke composition 13. A separate smoke pressure chamber is mounted on the cover 3 of the projectile container and substantially corresponds in its form and dimensions to the cover of the projectile container. This smoke pressure chamber consists essentially of a substantially flat cover 15 located inside the projectile container 1 and abutting on the cover 3 of the projectile container, and a base 17 spaced outside the projectile container 1 at a certain distance from the cover 15 of the smoke pressure chamber, the spacing between the cover 15 of the smoke pressure chamber or the cover 3 of the projectile container and the base 17 of the smoke pressure chamber being determined by spacer rings 19. In conjunction with these spacer rings 19 and the flange 7 of the projectile container 1, which is located on the cover 3 of the projectile container, the height of the smoke pressure chamber and thus the height of an annular slot 21 thus formed for the escape of the smoke gases at the outer edge of the smoke pressure chamber are determined. The individual components of the smoke pressure chamber are fixedly connected to the first end cover 3 of the projectile container 1 by means of screws 23, a total of three such screw connections being provided on the smoke pressure chamber, and being spaced at angles of about 120° to each other about the axis of said chamber. Suitable means are provided for ensuring a gastight seal of the screw connections.

The centre of the covers 3 and 15 and the base 17 of the smoke pressure chamber are bored to receive a central ignition charge unit which extends into the smoke compositions 11 and 13. This ignition charge unit consists of a sleeve 25 containing an ignition charge 27, and a securing ring socket 29 to which the sleeve 25 is connected by flanging and adhesive bonding and in which an ignition delay member 31 is provided. The ignition charge unit is held fixedly and in tightly sealed manner in the centre of the smoke pressure chamber by means of its securing ring socket 29 engaged by a cone ring 33 which in turn is engaged by a conical ring 35 with the inter-position of O-rings 37. The screws 23 also serve this purpose.

Moreover, in the cover 15 of the smoke pressure chamber, there are three throughflow openings 39 arranged at spacings of about 120°O, which coincide with corresponding outlet openings 41 in the cover 3 of the projectile container. This enables the smoke gases produced after ignition of the smoke compositions 11 and 13 in the projectile container to pass into the smoke pressure chamber.

A contact head is screwed on to the smoke pressure chamber by means of connecting screws 43, the connecting screws 43 passing through bores in the base 17 of the smoke pressure chamber, in the cover 3 of the projectile container and in the cover 15 of the smoke pressure chamber. Just as in the case of the screws 23 between the base 17 of the smoke pressure chamber and the cover 3 of the projectile container or the cover 15 of the smoke pressure chamber, spacer rings 19 are arranged round the connecting screws 43, whilst at total of three connecting screws 43 are provided, spaced at angles of 120° relative to one another about the axis of the chamber. Thus, in the components of the smoke pressure chamber 15, 17 the screws 23 and the connecting screws 43 alternate at angles of 60° relative to one another, so that there are a total of three screws 23 with spacer rings 19 and three fixing screws 43 with spacer rings 19.

The contact head consists of a solid metal core 45, made of aluminium in the embodiment shown, in the centre of which is formed a propellent charge chamber 49 containing a propellent charge 47. Located on the head portion of the metal core 45 facing the projectile container 1 there is a central bore 51 for receiving a connecting member for a corresponding ignition charge unit, which is connected to the propellent charge chamber 49, the propellent charge chamber 49 being sealed off from the central bore 51 by means of a protective film 53. In the solid part of the metal core 45 surrounding the propellent charge chamber 49, there are two firing circuit bores in which are located the firing circuit wires 71 of a primer capsule 73 embedded in the propellent charge 47. The firing circuit wires 71 are sealed off in the firing circuit bores by means of adhesive. Solely in the interests of clarity, the firing circuit bores and the firing circuit wires 71 are shown in a plane which coincides with a threaded hole 57 for a fixing screw 77 and with a perforation for receiving the head of the screw 23; in reality, however, they do not coincide with these components.

Also formed in the head part of the metal core 45 is an annular groove in which there is an annular seal 87 which provides additional sealing of the metal core 45 relative to the base 17 of the smoke pressure chamber abutting thereon.

In addition, in the solid part of the metal core 45 surrounding the propellent charge chamber 49, there is a first set of three stepped bores 55, which are stepped inwards from a shoulder, from the centre towards the head part of the metal core 45, and in which there are the connecting screws 43 for securing the canister-shaped projectile container. The individual bores 55 are thus located at an angle of about 120° relative to one another in the metal core 45. A second set of threaded holes 57 is also formed in the solid part of the metal core 45 surrounding the propellent charge chamber 49, between the bores 55 which form the first set, in the region of the base part of the metal core 45, and located in these holes 57 are the threaded necks of corresponding fixing screws 77 for securing a base plate 75 in position. Again, the threaded holes 57 of the second set are arranged in the lining of the metal core 45 at an angle of about 120° to one another. Thus, the bores 55 and the threaded holes 57 alternate in the solid lining of the metal core 45 at an angle of about 60° to one another.

Arranged around the metal core 45 is a protective band of elastic material, in this case synthetic rubber, which is made up of three individual rings in the embodiment shown, namely a top ring 59, a middle ring 61 and a bottom ring 63. Contact rings 67 are fitted on the outer surface of the top ring 59 and on the outer surface of the bottom ring 63, and have soldering tabs 69 located in recesses formed in the top ring 59 and in the bottom ring 63. The soldering tabs 69 are connected to the firing circuit wires 71 located in the firing circuit bores. The two contact rings 67 together with their soldering tabs 69 and the firing circuit wires 71 are kept separate and insulated from each other by the middle ring 61. The protective band is constructed so as to project to form a sealing bead 65 in its region located at the head part of the metal core 45, i.e. at the top ring 59. This ensures a tight-fitting seal of the contact head in a corresponding launcher.

The base plate 75 is formed with a total of six bores 79 of substantially the same size, which coincide with the bores 55 and threaded holes 57 in the metal core 45. The size of the bores 79 is such that the connecting screws 43 in the bores 55 of the metal core 45 cannot fall out through the base plate 75, and the fixing screws 77 for the base plate 75 can be inserted in the bores 79 in the base plate 75 which are opposite the threaded holes 57 of the metal core 45. In its central region opposite the propellent charge chamber 49 of the metal core 45, the base plate 75 is formed a plurality of gas outlet ports 81 in the form of breakage points, which are sealed off from the atmosphere by covering films 83, which in this case are tin foil sealed with sealing lacquer. A sealing ring 85 provides a tight seal between the propellent charge chamber 49 and the base plate 75.

A firing pin ignition unit 89 which can be actuated by manual tension is mounted on the projectile container 1 at the opposite end thereof from the contact head. The unit 89 is essentially a firing pin ignition unit of conventional construction, and therefore, there is no need to describe it in detail. An inner mounting plate 93 arranged on the inside of the second end cover 5 of the projectile container, in conjunction with an elastic covering cap 95 and an outer mounting plate 97, serves to secure this firing pin ignition unit 89 to the end cover 5 of the projectile container. The elastic covering cap 95 is a conventional protective cap, but it engages fully in the chamber formed by the end cover 5 of the projectile container and the flange 9 of the casing of the canister-type projectile container and is therefore

reinforced in this region. For the purpose of providing connections between the inner mounting plate 93, the end cover 5 of the projectile container, the elastic covering cap 95 and the outer mounting plate 97, these components comprise coinciding bores with threaded portions in which clamping screws 99 are located. When these clamping screws 99 are tightened, the elastic covering cap 95 is pressed tightly against all the components surrounding it. In the centre of these components, which is axially opposite the sleeve 25 of the central ignition charge unit, there is a continuous bore in which a securing sleeve 101 is located. At the end of this securing sleeve 101 facing the inside of the projectile container 1, there is mounted a guide sleeve which extends into the smoke composition 13 and practically as far as the end of the sleeve 25 of the central ignition charge unit. The internal diameter of this guide sleeve 103 corresponds substantially to the outer diameter of the firing pin ignition unit 89 provided therein. The firing pin ignition unit 89 comprises an igniter head 105 which broadens out to an annular seating 107 at its portion located outside the securing sleeve 101 and facing the outer mounting plate 97, the firing pin ignition unit 89 being located in tightly sealed manner in the projectile container 1 by means of an O-ring 109 engaging in an appropriate groove. On an annular portion of the igniter head 105 there is further provided another O-ring 111 by means of which a protective cap 113 can be sealed on to the firing pin ignition unit 89. A connection between the firing pin ignition unit 89 and the sleeve 25 of the central ignition charge unit is provided by a coupling member 115, which engages round an igniter neck 117 of the firing pin ignition unit 89 and is sealed off by an O-ring 121 in the region of the another ignition delay member 119 located in the igniter neck 117. A mechanical connection between the coupling member 115 and the guide sleeve 103 is provided by a ring cone 123. This ensures a gastight, mechanically stable but not totally inelastic connection between the firing pin ignition unit 89 and the sleeve 25 of the central ignition charge unit. At the same time, it enables the firing pin ignition unit 89 to be removed, if desired, and optionally replaced by another firing pin ignition unit.

CLAIMS

1. A smoke projectile, comprising a sidewall and first and second end covers together constituting a projectile container in the form of a canister and of sufficient strength to be capable of withstanding the pressure generated by hot smoke gases upon ignition of a smoke composition in the container, said first end cover being formed with a central aperture and with a plurality of outflow apertures surrounding said central aperture, a central ignition charge unit extending into said smoke composition from one end of said container and through the central aperture in said first end cover, an ignition charge to said ignition charge unit, a contact head, formed with a central propellent charge chamber, a propellent charge in said chamber, a primer capsule to said contact head for igniting said propellent charge, firing circuits to said contact head, contact rings arranged in the outer surface of the contact head whereby an electric current can be passed through said contact rings and said firing circuits to fire said primer capsule, an ignition delay member connecting the ignition charge unit to the propellent charge chamber coaxially of the projectile, a substantially flat smoke pressure chamber cover fixedly connected to said first end cover and formed with throughflow apertures in register with the outflow apertures in said first end cover, a smoke pressure chamber base, and spacer members arranged between the smoke pressure chamber cover and base thereby to define a smoke pressure chamber of substantially the same peripheral extent as the first end cover with an annular slot for the escape of smoke gases.

2. A smoke projectile as claimed in claim 1, wherein the annular slot for the escape of the smoke gases is formed and defined between a flange of the first end cover of the projectile container and the base of the smoke pressure chamber.

3. A smoke projectile as claimed in claim 1 or 2, wherein the first end cover of the projectile container is arranged between the cover and the base of the smoke pressure chamber.

4. A smoke projectile as claimed in any one of the preceding claims, wherein a firing pin ignition unit which can be actuated by manual tension is also provided.

5. A smoke projectile as claimed in claim 4, wherein the firing pin ignition unit is mounted on the second end cover of the projectile container, coaxially with a sleeve of the ignition charge unit, and also extends into the smoke composition, and wherein the firing pin ignition unit is connected to the ignition charge unit via another ignition delay member to form a central channel extending right through the smoke composition.

6. A smoke projectile as claimed in any one of the preceding claims, wherein the smoke composition comprises a chlorinatedhydrocarbon, a reaction-accelerating metal powder and titanium dioxide.

7. A smoke projectile as claimed in claim 6, wherein the smoke composition contains hexachloroethane as the chlorinatedhydrocarbon and aluminium powder as the reaction-accelerating metal powder.

8. A smoke projectile as claimed in claim 6 or 7, wherein the smoke composition comprises 50 to 70% by weight hexachloroethane, 5 to 20% by weight aluminium powder and 20 to 30% by weight titanium dioxide.

9. A smoke projectile as claimed in claim 7 or 8, wherein the smoke composition comprises 60 to 65% by weight hexachloroethane, 7 to 15% by weight aluminium powder and 25 to 28% by weight titanium dioxide.

10. A smoke projectile substantially as hereinbefore described with reference to the accompanying drawing.

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